Melting Practice for Sand Casting

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The choice of furnace type is based on these four factors.

- Alloy Type
- Metal Quality
- Production Demands
- Economics

Melting Point

Metal Alloy Type	Temp Range (Celsius)
Zinc	345-455
Aluminum	620-735
Magnesium	620-735
Copper	908-1180
Cast Irons	1340-1480
High Manganese Steel	1400-1455
Monel (70N, 30Cu)	1370-1540
Nickel Based Super Alloys	1430-1540
High Alloy Steels	1480-1600
High Alloy Irons	1540-1650
Carbon & Low Alloy Steel	1565-1700
Titanium	1700-1820
Zirconium	1845-1900

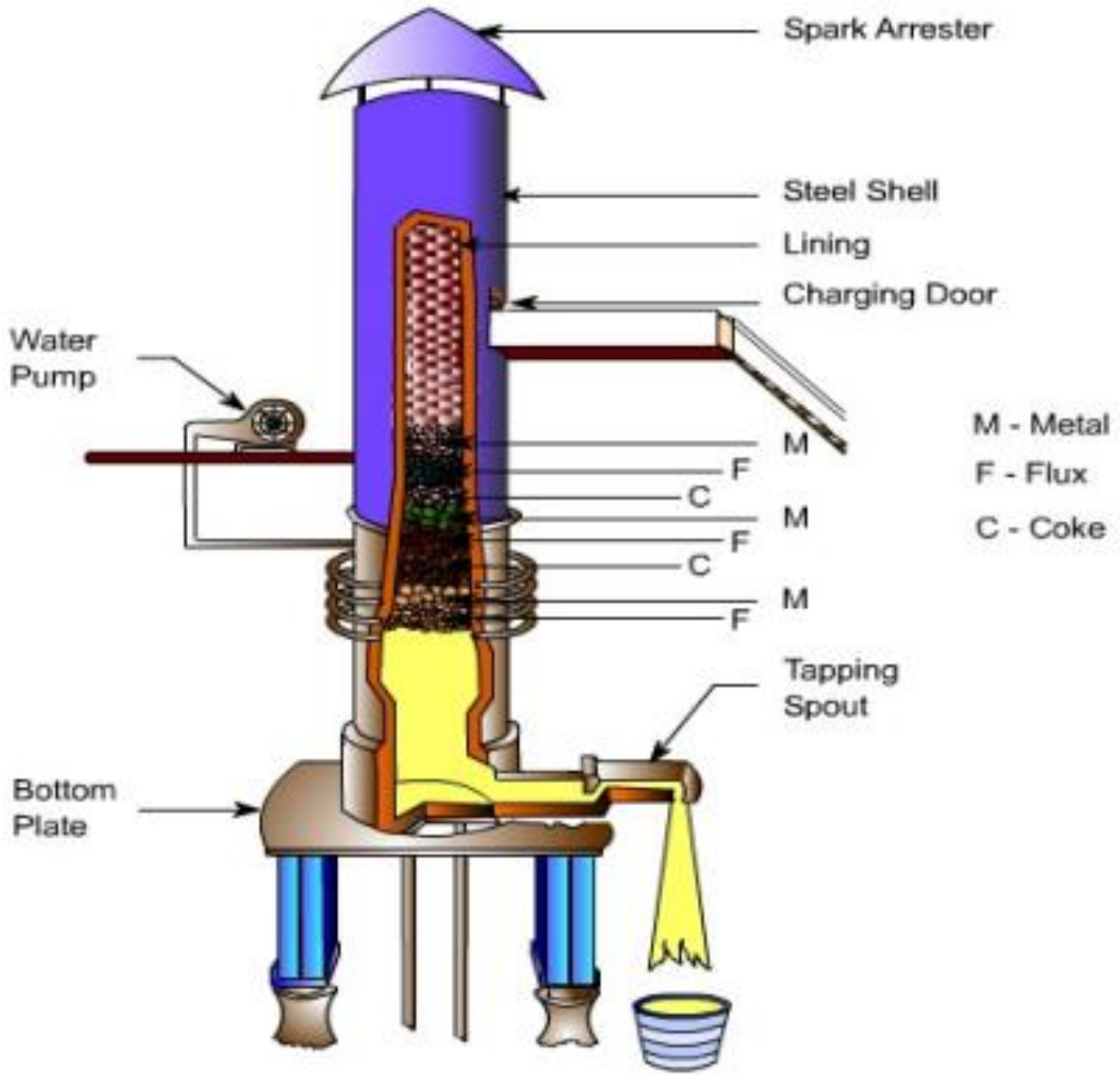
Melting point of common materials

- Metal Quality is affected by oxidization and losses due to vaporization, which can adversely affect the chemical properties of the alloy being melted. Similarly the types of refractory used are matched to the basicity or acidity of the metal and/or its resultant (Dross or slag).
- Production demand can range from small batches under 30 Kg through to 100 tonne/hr continuous pour furnaces that run for days and weeks at a time uninterrupted.
- The economics of furnace selection relate to factors of capital depreciation, maintenance and operating labour, as well as the fuel and power consumption.

Types of Furnace: CUPOLA

- It consists of a cylindrical steel shell with its interior lined with heat resisting fire bricks.
- It has drop doors at the bottom. After closing the door a proper sand bed is prepared. This sand bed provides necessary refractory bottom for the molten metal and the coke.
- Immediately above the sand bed is the metal tapping hole which is initially closed with clay till the molten metal is ready for tapping.
- Above the metal tapping hole normally in a position opposite to is the slag hole through which the slag generated during the melting process is tapped.

Types of Furnace: CUPOLA



Types of Furnace: CUPOLA

- Above the slag hole is the wind box which is connected to the air blowers supplying the requisite air at a given pressure and quantity.
- The lining is generally thicker in the lower portion of the cupola as the temperatures are higher compared to those in upper portion.
- There is a charging door through which coke, pig iron, steel scrap and flux is charged.
- The blast is blown through the tuyeres.

Types of Furnace: CUPOLA

- These tuyeres are arranged in one or more row around the periphery of cupola.
- Hot gases which ascend from the bottom (combustion zone) preheat the iron in the preheating zone.
- Cupolas are provided with a drop bottom door through which debris, consisting of coke, slag etc. can be discharged at the end of the melt.
- At the top conical cap called the spark arrest is provided to prevent the spark emerging to outside.

Types of Furnace: CUPOLA

- Most of the foundries operate on a batch basis. A number of sand moulds are prepared and kept ready for pouring before the molten metal is prepared.
- This process may take a few days to weeks depending upon the size and nature of the foundry plant.
- Thus it becomes necessary only to start melting may be once a week or so.

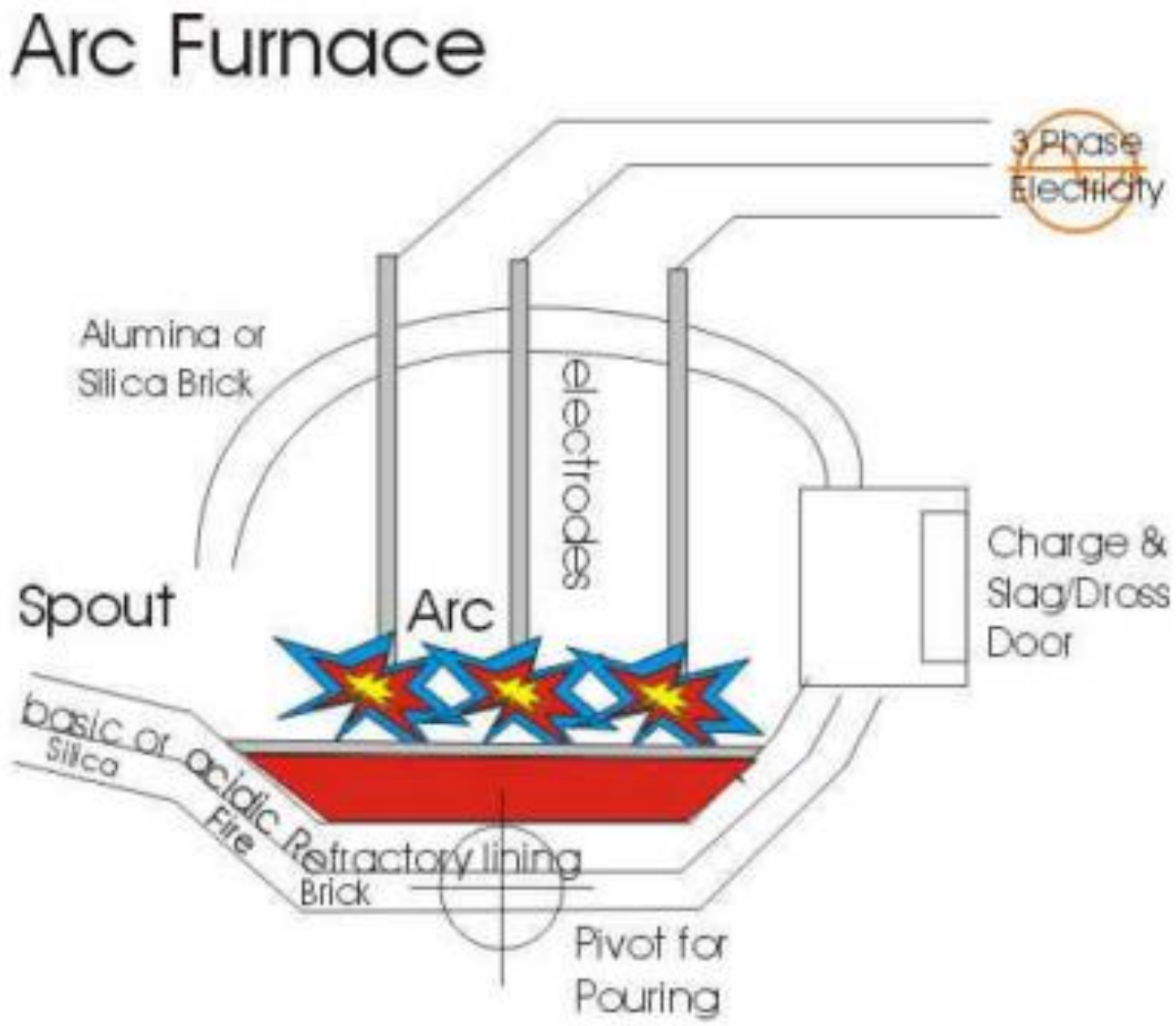
Types of Furnace: CUPOLA

- Cupola has been the most widely used furnace for melting cast iron.
- This is because of the low cost of melting.
- However, less control of the final quality, and the losses involved would call for some change in the choice.
- Therefore liquid or gas fired furnaces and electric furnaces are becoming popular because of their better control of melting process and low melting losses.

Types of Furnace: ELECTRIC FURNACE

For heavy steel castings, the open hearth type of furnaces with electric arc would be suitable in view of the large heat required for melting. Due to good temperature control and flexibility of operation, this furnace is widely used for melting for small to medium sized castings in ferrous as well as non-ferrous alloys. There are three types of electric furnaces on the basis of source of heating (Arc, Resistance, and Induction).

Types of Furnace: ELECTRIC ARC FURNACE



Types of Furnace: ELECTRIC ARC FURNACE

In above figure three electrodes are used that are tied to a 3 phase electrical source. The electrodes strike an arc with the metal charge. The heat of the sustained arc can be in excess of 4000 degree C. With such extreme heat comes the requirement of cooling with water jackets, heat exchangers and recirculation systems. Arc furnaces are of two types; Direct and Indirect types.

Types of Furnace: ELECTRIC ARC FURNACE

- Arc Furnaces can be configured with "Ultra-High-Powered" (UHP) transformers that can supply 600-900KVA/tonne.
- The furnace can have a pivoting point with a hydraulic actuator to tilt the furnace backward to skim of the dross/slag or forward to pour off the metal.
- The high temp capacity of this furnace lends itself better toward ferrous casting than non ferrous.
- The electrodes can be either graphite or carbon, and are selected to match the type of metal being melted.

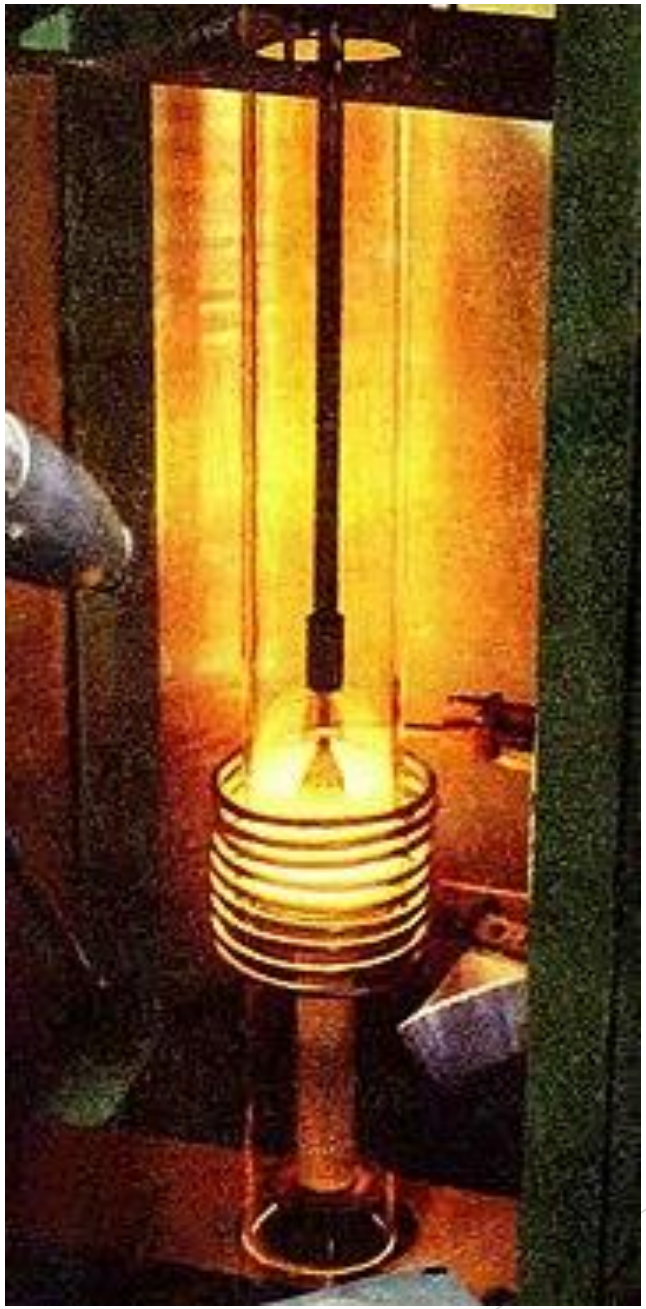
Types of Furnace: ELECTRIC ARC FURNACE

- The Indirect Arc furnace is similar in principle, but the arc is struck above the metal charge and heat is transferred to the charge by radiation.
- The indirect furnace also can be a sealed unit that operates under a reduced atmosphere for specialty metals that are sensitive to oxidization or atmospheric contamination.

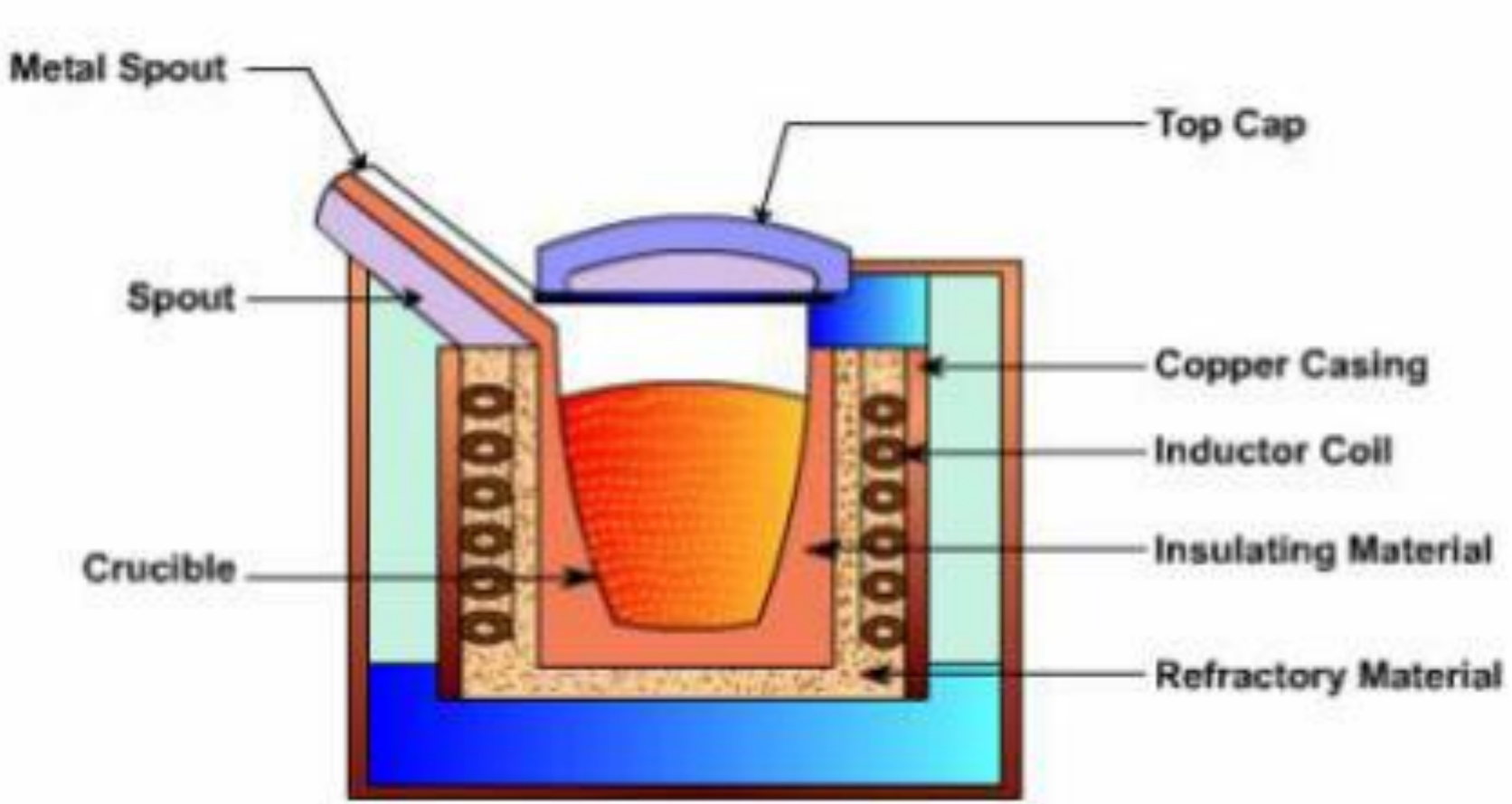
Types of Furnace: INDUCTION FURNACE

- Induction heating is a heating method.
- The heating by the induction method occurs when an electrically conductive material is placed in a varying magnetic field.
- Induction heating is a rapid form of heating in which a current is induced directly into the part being heated.
- Induction heating is a non -contact form of heating.
- The heating system in an induction furnace includes:

1. Induction heating power supply,
2. Induction heating coil,
3. Water-cooling source, which cools the coil and several internal components inside the power supply



Types of Furnace: INDUCTION FURNACE



Types of Furnace: INDUCTION FURNACE

- The induction heating power supply sends alternating current through the induction coil, which generates a magnetic field.
- Induction furnaces work on the principle of a transformer.
- An alternative electromagnetic field induces eddy currents in the metal which converts the electric energy to heat without any physical contact between the induction coil and the work piece.

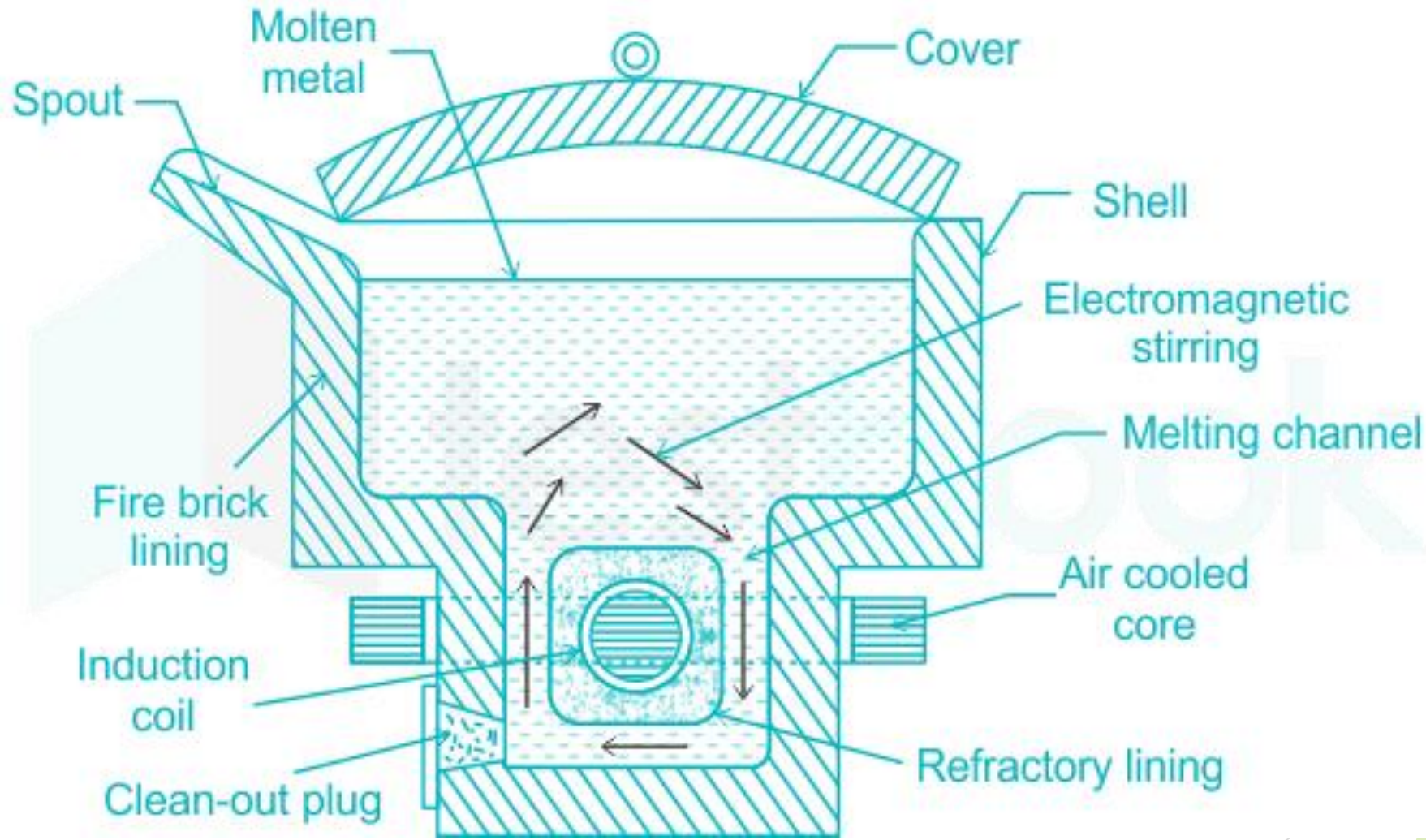
Types of Furnace: INDUCTION FURNACE

- The furnace contains a crucible surrounded by a water cooled copper coil. The coil is called primary coil to which a high frequency current is supplied.
- By induction secondary currents, called eddy currents are produced in the crucible.
- High temperature can be obtained by this method. Induction furnaces are of two types: cored furnace and coreless furnace.

Types of Furnace: INDUCTION FURNACE

- Cored furnaces are used almost exclusively as holding furnaces.
- In cored furnace the electromagnetic field heats the metal between two coils. Coreless furnaces heat the metal via an external primary coil.
- Non ferrous metals are melted using cored furnace while ferrous metals are melted using coreless induction furnace.

Types of Furnace: INDUCTION FURNACE



Types of Furnace: INDUCTION FURNACE

Advantages

- Induction heating is a clean form of heating
- High rate of melting or high melting efficiency
- Alloyed steels can be melted without any loss of alloying elements
- Controllable and localized heating

Types of Furnace: INDUCTION FURNACE

Disadvantages

- High capital cost of the equipment
- High operating cost

Types of Furnace: ELECTRIC RESISTANCE FURNACE

- A series of Ni-Chrome elements are energized around the crucible and the radiant energy is absorbed by the Crucible and the metal.
- Unlike the Core/Channel Induction furnace ER type systems can take solid charge material.
- The resistance type heating is generally used for holding furnaces to maintain the liquid metal at a certain temperature for non-ferrous alloys such as for die casting.
- This has no noise, fumes, flames or potential for disaster.

Types of Furnace: ELECTRIC RESISTANCE FURNACE